

Armed Forces College of Medicine

AFCM



Diencephalon

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INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

1. Define the diencephalon and its parts.
2. Mention the major relations & blood supply of the thalamus
3. List the different thalamic nuclei and their connections and functions.
4. List parts and connections of metathalamus
5. Describe the parts of hypothalamus, epithalamus & subthalamus.
6. Describe the communications boundaries & recesses of the third ventricle.

Key points



1. Thalamus
2. Metathalamus & Epithalamus
3. Subthalamus & Hypothalamus
4. 3rd Ventricle

Parts of Diencephalon

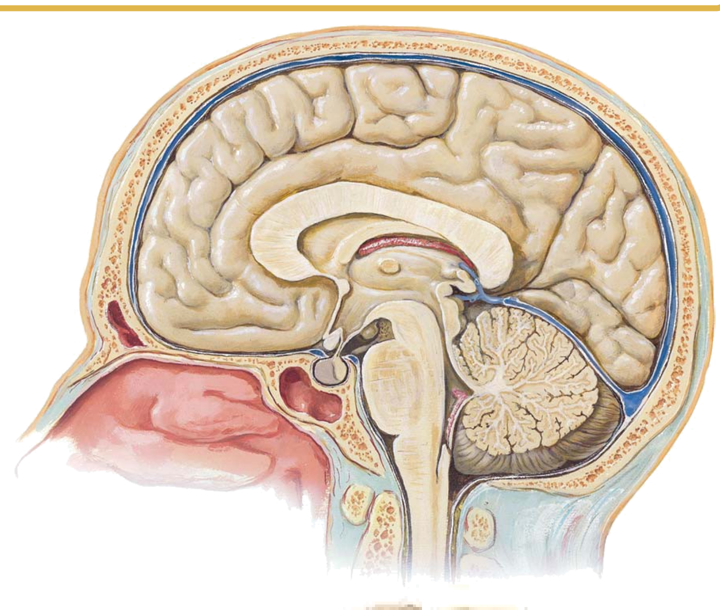


- *Divided by **3rd ventricle** into 2 halves:*
- *Each half is divided by **hypothalamic sulcus** into :*
- ***Dorsal parts include:***
  - ***Thalamus, Epithalamus & Metathalamus***
- ***Ventral part include:***
  - ***Hypothalamus & Subthalamus***

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Thalamus

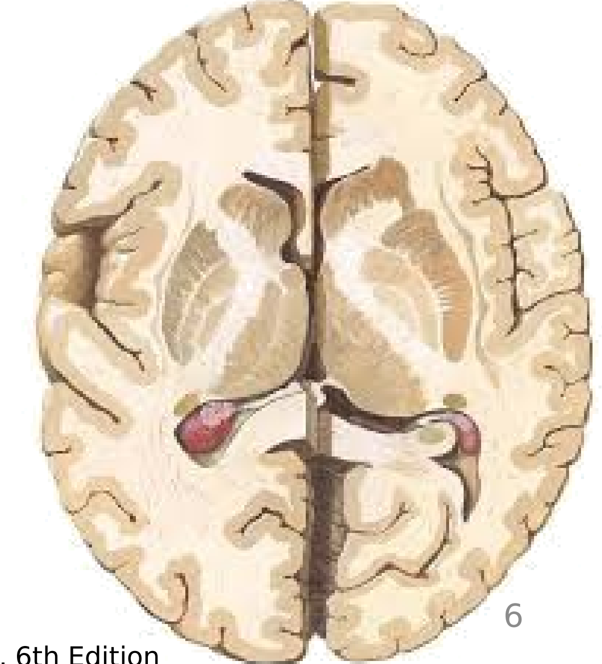




- *Oval mass of grey matter acts as a gateway for the cerebral cortex*
- *Relays all sensations* ***except smell***

- ***The thalamus has 4 surfaces & 2 ends :***

1. ***Medial surface*** *forms lat wall of 3rd ventricle*
2. ***Lateral surface*** *is separated from lentiform nucleus by internal capsule.*
3. ***Inferior surface*** *is separated by hypothalamic sulcus from subthalamus & hypothalamus.*
4. ***Superior surface*** *lies in the floor of body of lateral ventricle*



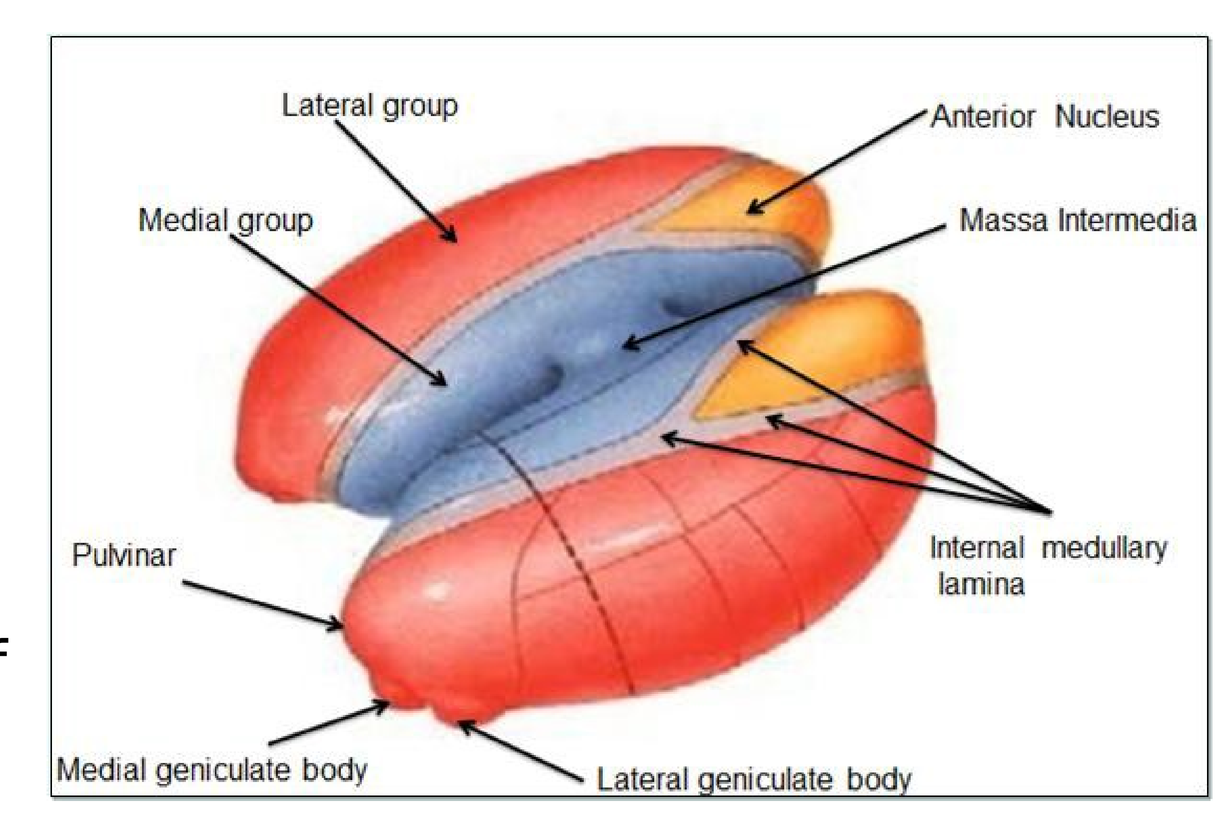
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Thalamic Nuclei

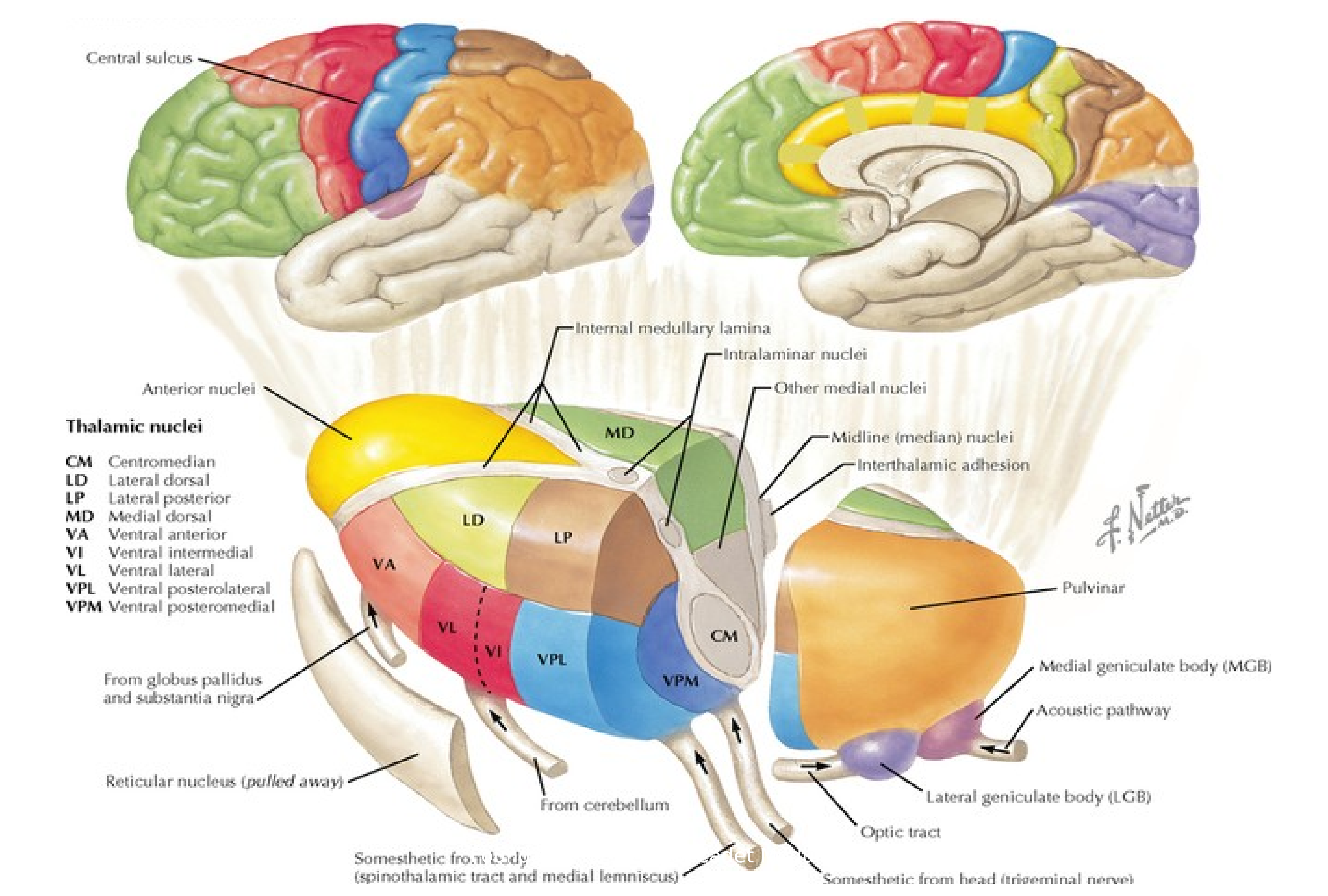


The thalamus is divided by a **Y-shaped *internal medullary* lamina** *into:*

- **Anterior group:** Between forks of the lamina
- **Medial group:** Medial to the lamina
- **Lateral group:** Lateral to the lamina



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Central sulcus
Internal medullary lamina
Intralaminar nuclei
Other medial nuclei
Anterior nuclei
Thalamic nuclei
CM Centromedian
LD Lateral dorsal
LP Lateral posterior
MD Medial dorsal
VA Ventral anterior
VI Ventral intermedial
VL Ventral lateral
VPL Ventral posterolateral
VPM Ventral posteromedial
Midline (median) nuclei
Interthalamic adhesion
MD
LD
LP
VA
VL
VI
VPL
VPM
CM
Pulvinar
Medial geniculate body (MGB)
Acoustic pathway
From globus pallidus
and substantia nigra
Reticular nucleus (pulled away)
From cerebellum
Lateral geniculate body (LGB)
Optic tract
Somesthetic from body
(spinothalamic tract and medial lemniscus)
Somesthetic from head (trigeminal nerve)
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Anterior Group of Thalamic Nuclei



Efferent

Cingulate gyrus
(part of limbic system)
(via anterior thalamic radiation)

Anterior nuclei

Afferent

Mammillary body of hypothalamus
(via mammillo-thalamic tract)

Function

Forms part of the limbic system
(Papez circuit)
(concerned with emotions and recent memory)

Internal medullary lamina
Intralaminar nuclei
Other medial nuclei
Midline (median) nuclei
Interthalamic adhesion
MD
LD
LP
VA
VL
VI
VPL
VPM
CM
Pulvinar
Medial geniculate body (MGB)
Acoustic pathway
Lateral geniculate body (LGB)
Optic tract
From cerebellum
From globus pallidus and substantia nigra
Reticular nucleus (pulled away)

Medial Groups of Thalamic Nuclei



Efferent

to the prefrontal cortex
(via the medial forebrain bundle)

Dorsomedial Nucleus

Anterior nuclei
Other medial nuclei
MD
Midline (median) nuclei
Interthalamic adhesion
LD
LP
VA
VL
VI
VPL
VPM
CM
Pulvinar
Medial geniculate body (MGB)
Acoustic pathway
Lateral geniculate body (LGB)
Optic tract
From globus pallidus and substantia nigra
Reticular nucleus (pulled away)
From cerebellum

Afferent

Hypothalamus
Amygdala
Olfactory cortex

Function

Forms part of the limbic system involved in thinking & mood

Lateral Group of Thalamic Nuclei





Internal medullary lamina
Intralaminar nuclei
Anterior nuclei
Other medial nuclei
MD
Midline (median) nuclei
Interthalamic adhesion
LD
LP
VA
Pulvinar
VL
CM
VI
VPL
VPM
Medial geniculate body (MGB)
From globus pallidus and substantia nigra
Acoustic pathway
Reticular nucleus (pulled away)
Lateral geniculate body (LGB)
From cerebellum
Optic tract

Ventral Tie

Lateral Group of Thalamic Nuclei



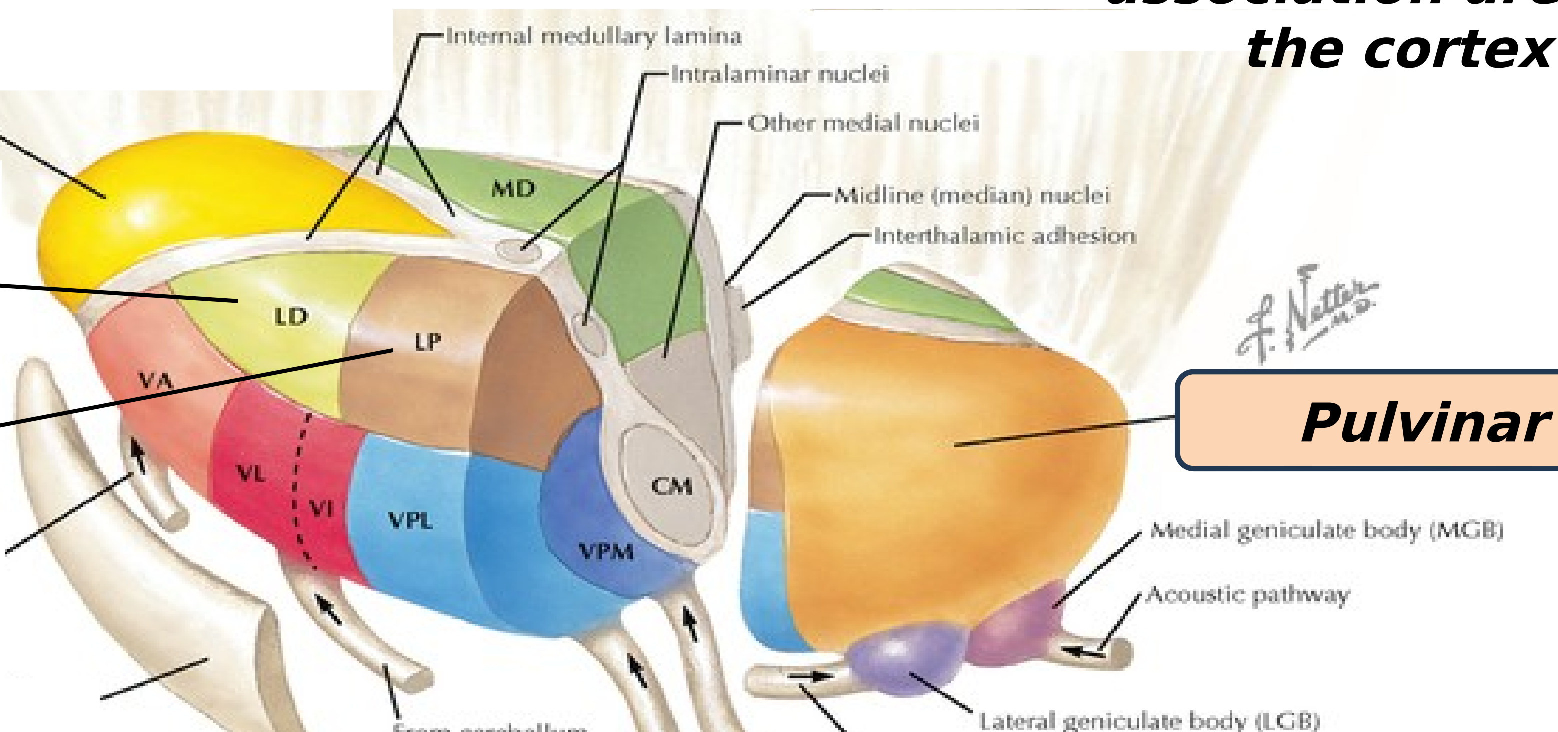
Dorsal Tier

Afferent

From the other thalamic nuclei

Efferent

to the sensory association areas of the cortex



Lat.dorsal Nc.

Lat. Posterior Nc.

Pulvinar

- ***Integrate impulses from***

The thalamus is considered as a multisensory processing unit

Lateral Group of Thalamic Nuclei



Ventral Tier

Internal medullary lamina
Intralaminar nuclei
Other medial nuclei
Anterior nuclei
MD
Midline (median) nuclei
Interthalamic adhesion
LD
LP
VA
Pulvinar
VL
VI
VPL
CM
VPM
Medial geniculate body (MGB)
Acoustic pathway
Lateral geniculate body (LGB)
Optic tract

Ventral anterior

Ventral intermdiate

Ventral Posterior

VPL N

VPM N

Lateral Group of Thalamic Nuclei



Ventral Tier

Ventral anterior

***Function*:** motor

***Afferent*:** Basal ganglia (globus pallidus)

***Efferent*:** Supplementary motor area

…tral Intermdiate

***Function*:**

- Relays motor planning of voluntary movement

***Afferent*:** Cerebellar nuclei

***Efferent*:** Motor and premotor areas

Internal medullary lamina
Intralaminar nuclei
Other medial nuclei
Midline (median) nuclei
Interthalamic adhesion
MD
LD
LP
VA
VL
VI
VPL
VPM
CM
Pulvinar
Medial geniculate body (MGB)
Acoustic pathway
Lateral geniculate body (LGB)
Optic tract
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Lateral Group of Thalamic Nuclei



Ventral Posterior

Ventral Tier

Internal medullary lamina
Intralaminar nuclei
Other medial nuclei
Anterior nuclei
MD
Midline (me... nuclei
Int...alamic adhesion
LD
LP
VA
VL
VI
From globus pallidus and substantia nigra
Reticular nucleus (pulled away)
From cerebellum
Medial geniculate body (MGB)
Acoustic pathway
Lateral geniculate body (LGB)
Primary motor cortex (M1)
Hip
Trunk
Arm
Hand
Foot
Face
Tongue
Larynx

VPL N

VPM N

upper 2/3 of Somatosensory Area

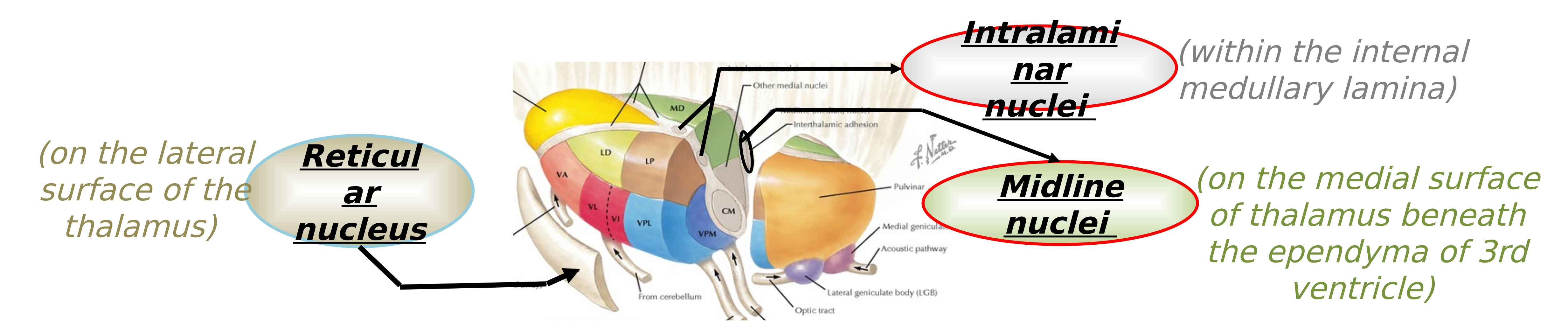
lower 1/3 of somatosensory area

Medial lemniscus Spinal lemniscus

Trigeminal lemniscus & solitariothalamic tract (carrying taste)

Other Thalamic Nuclei





***Afferents**: from whole cerebral cortex.*

***Efferents**: do not leave the thalamus but end on the thalamic nuclei*

***Functions**: inhibits the thalamic nuclei dur*

***Afferents**: Reticular formation*

***Efferents**: to the whole cortex non-specifically; increases its activity*

***Functions**: part of RAS responsible for a*



Metathalamus



MGB LG B

Light

Lateral geniculate body (LGB)

Music

Medial geniculate body (MGB)

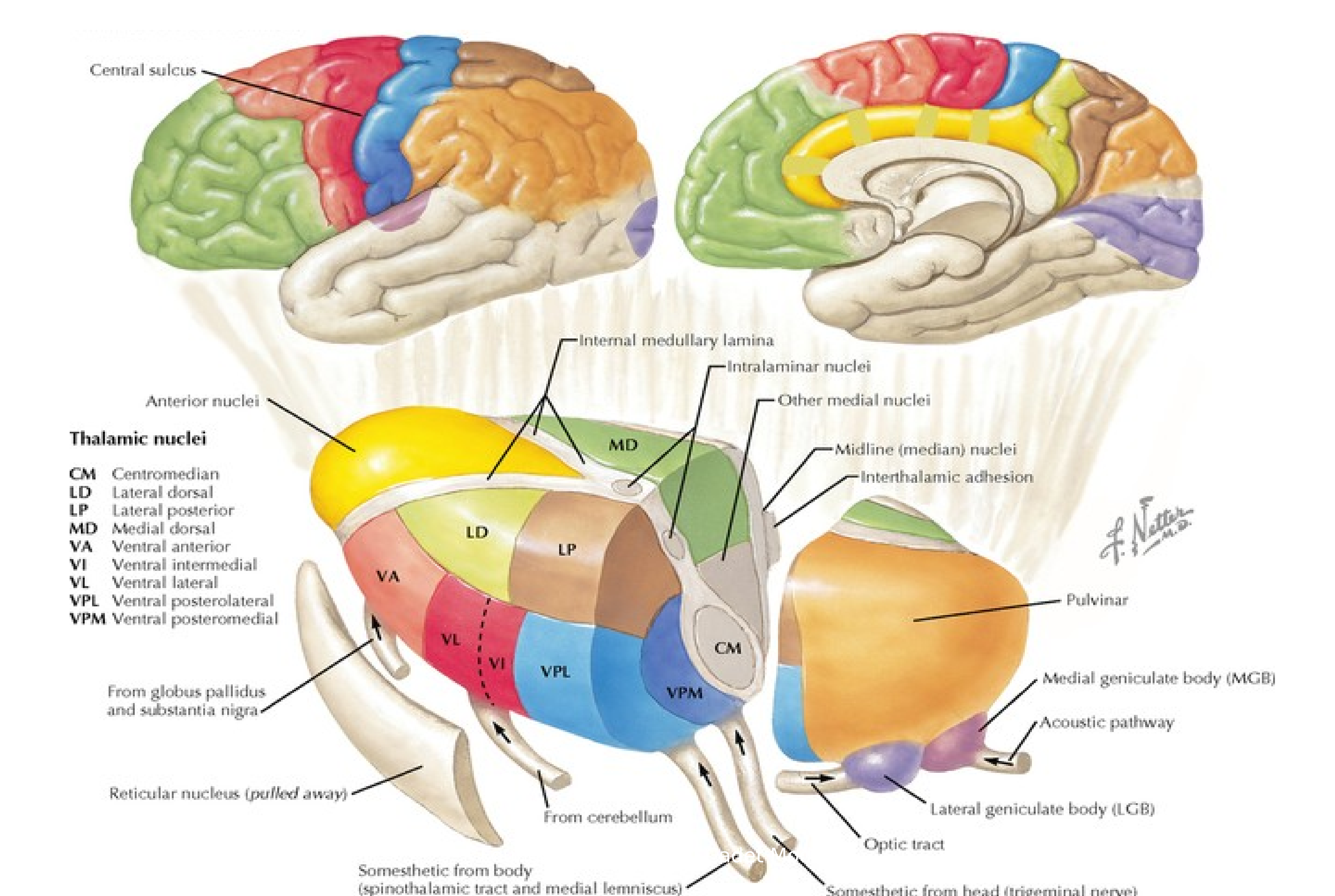
MG B LG B

Receives
visual input from the optic tract.

Projects
optic radiation to the visual area of cortex.

Receives
auditory input from the inferior colliculus of midbrain.

Projects
auditory radiation to the auditory area of cortex.


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Blood Supply



Arterial supply : posterior cerebral artery (Thalamo-geniculate)

Venous drainage: Thalamo-striate vein

Lecture Quiz



- Which of the following thalamic nuclei is concerned with thought & judgement:

a) Anterior nuclear group
b) Medial nuclear group
c) pulvinar
d) Ventral posterior nucleus

Epithalamus



❖ ***Pineal Body***

- ***Site:*** *between 2 sup. colliculi. Inf. to splenium of corpus callosum*
- ***Its stalk forms 2 laminae***

Sup. lamina *contains* ***habenular commissure***

Inf. lamina *contains* ***posterior commissure***

- ***Function:***

1- Endocrine gland inhibits pituitary gland, pancreas, parathyroids, adrenal cortex and gonads.

2- Active in dark secretes ***melatonin hormone***

- *After puberty, it becomes calcified forming* ***brain sand***

Habenular Ns

Posterior commissure

Pineal body

Epithalamus

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Subthalamus



- ***Site:*** *below thalamus, separated from it by hypothalamic sulcus. Med.to hypothalamus.*

- *It is functionally related to **basal ganglia** (involved in control of muscular activity)*

- ***Lesion*** → ***Hemiballismus*** *(Contralat. severe violent involuntary movement).*

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Hypotahalmus



Lies below thalamus, separated from it by Hypothalamic sulcus

Site &

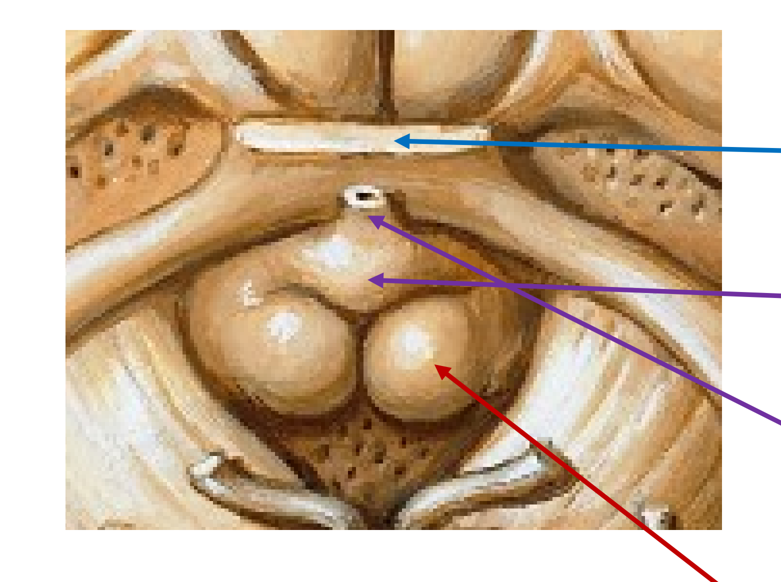
Superiorly:
hypothalamic sulcus

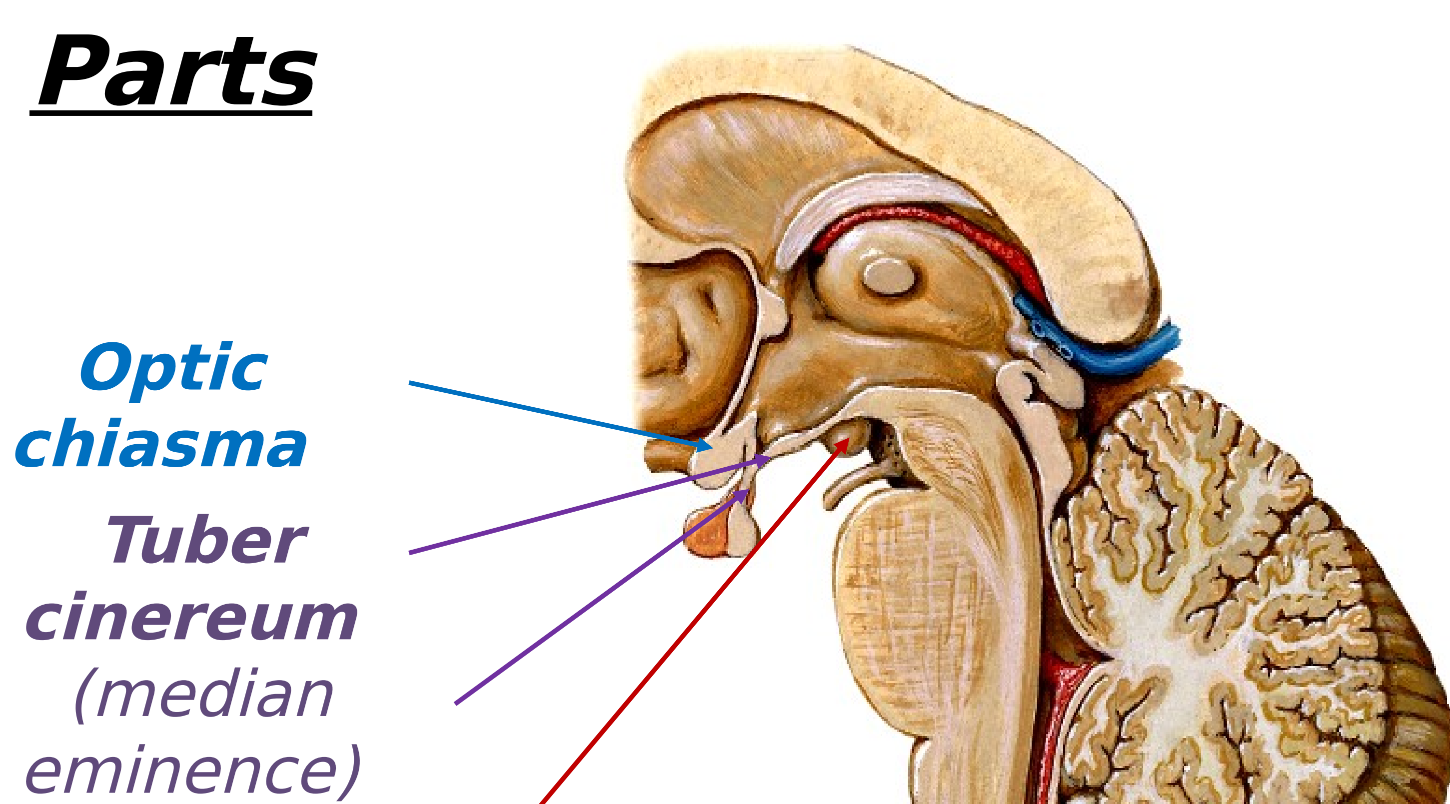
Anteriorly:
lamina terminals

Posteriorly:
Vertical plane posterior to mammillary bodies

Inferiorly:
Forms the base of the brain beneath the 3rd ventricle (the floor of interpeduncular fossa)

Parts



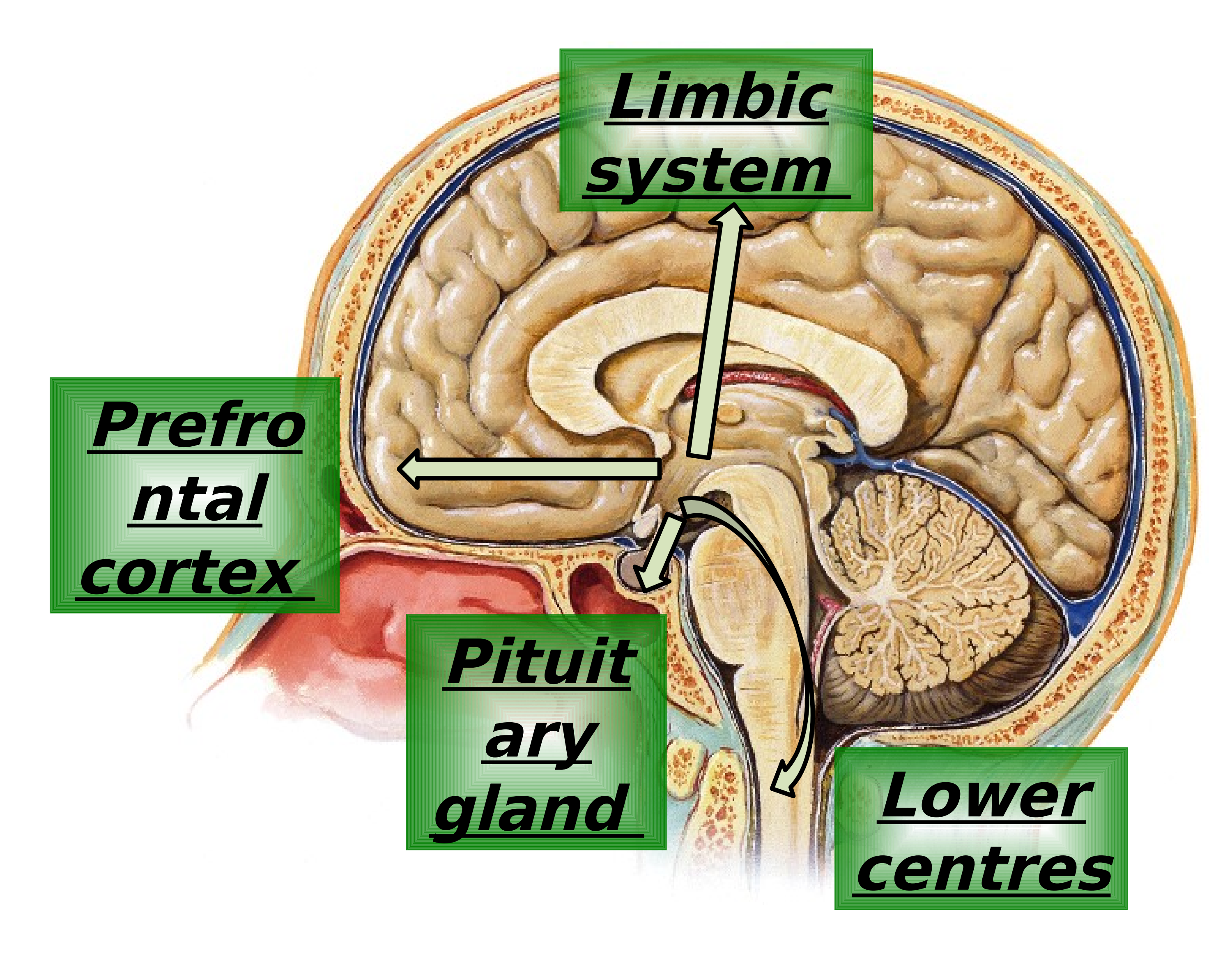


Optic chiasma

Tuber cinereum (median eminence) & infundibular stalk

Mammillary bodies

Connections

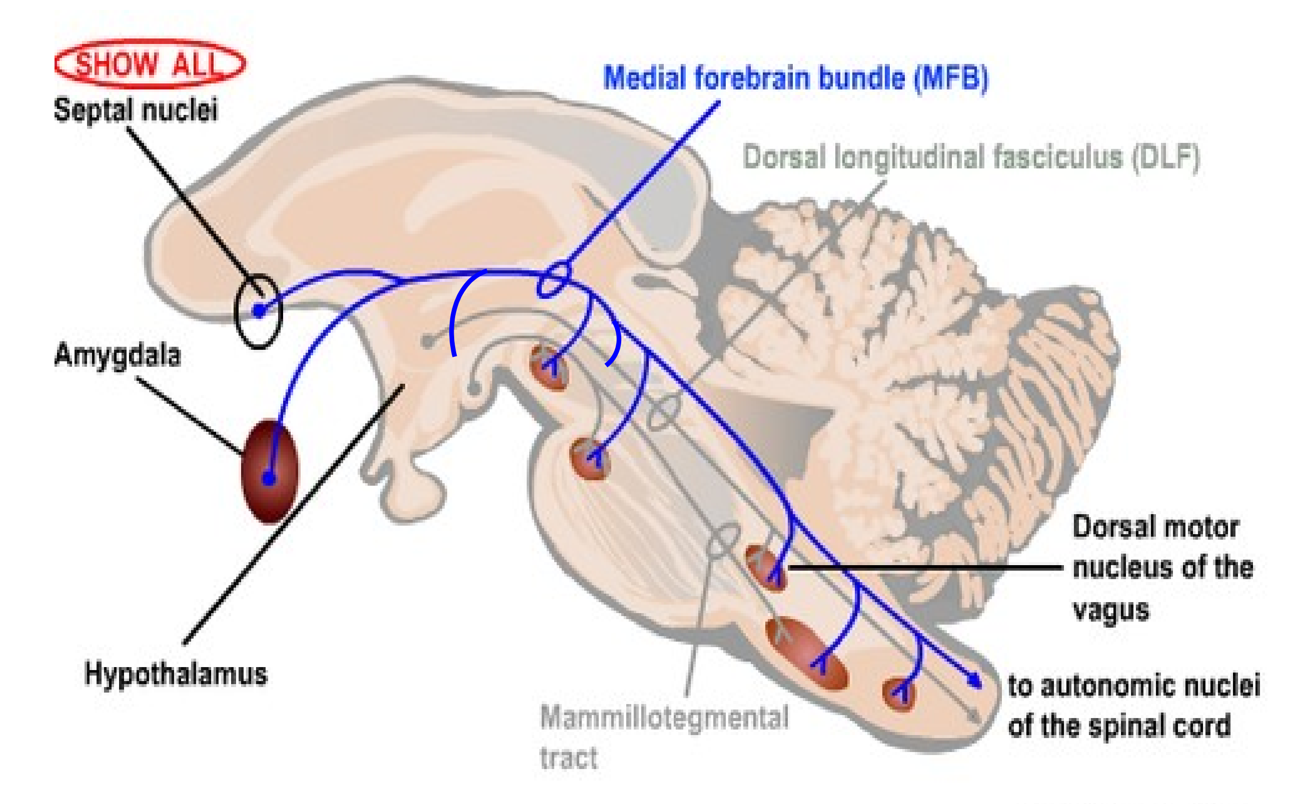


The medial forebrain bundle

(Both –ways connection)

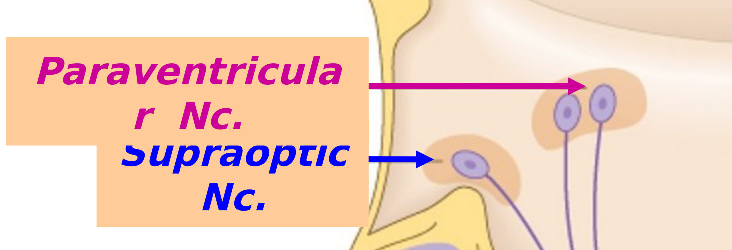
- ***Central grey of the brain stem***
- ***Hypothalamus***
- ***Amygdala***
- ***Septal areas***

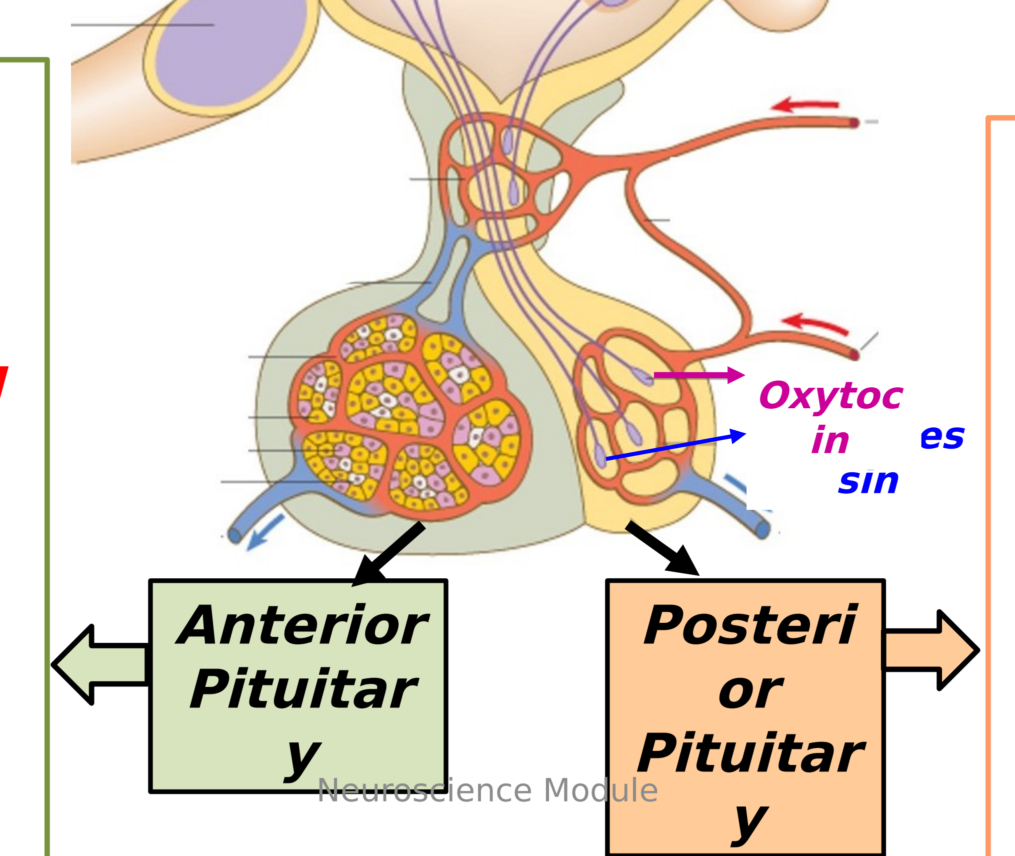
It contains most serotonergic & noradrenergic fibers



Pituitary Gland Connection







Vascular Connection

Hypothalamo-hypophyseal Portal System

Hypothalmus secretes releasing hormones and release-inhibiting hormones via sets of capillaries

Anterior Pituitary

Posterior Pituitary

Nervous connection

Supraoptic N. vasopressin

Paraventricular N. oxytocin

Both Pass through axons to posterior pituitary where they are absorbed by blood capillaries.

Lecture Quiz



- Lat geniculate body is concerned with

a) Taste
b) Vision
c) Hearing
d) Smell

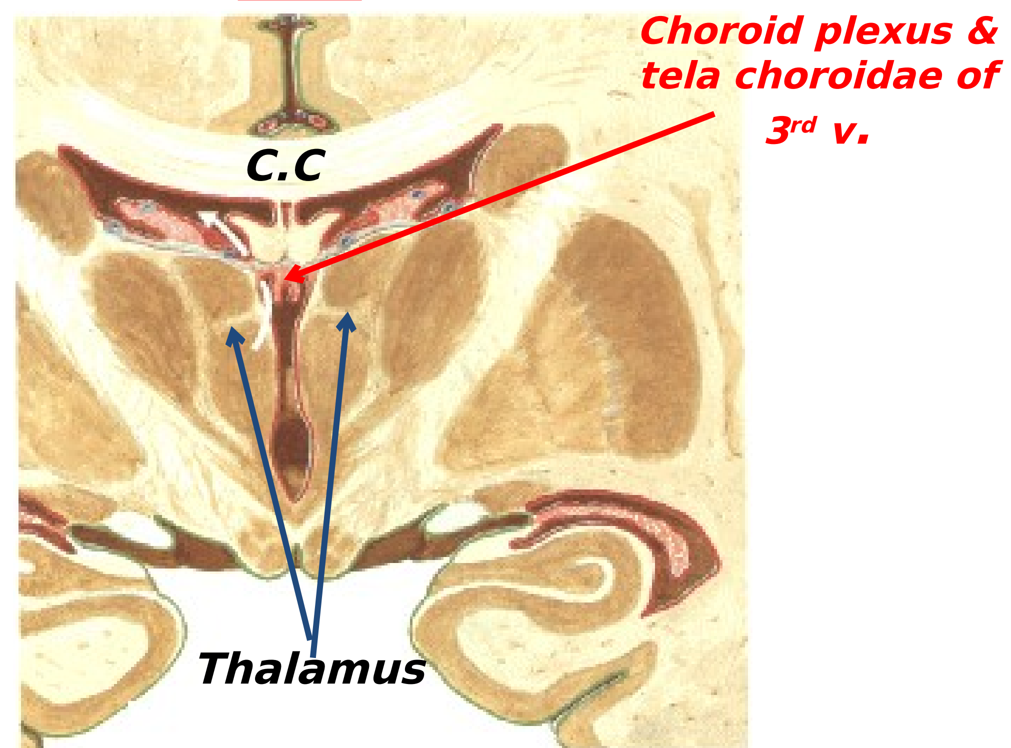


3rd Ventricle
(Cavity of the Diencephalon)

❖Boundaries

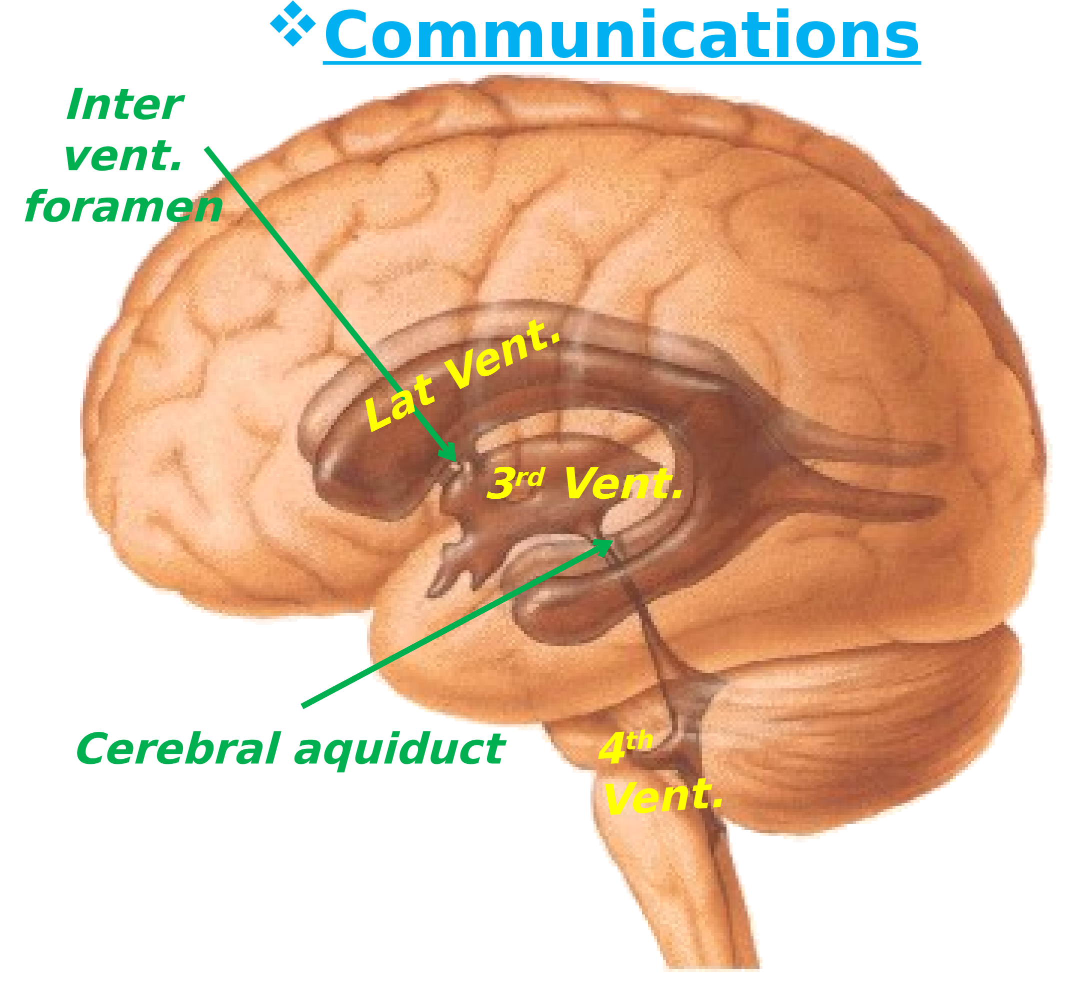
has roof, floor, anterior, posterior & lateral walls.

Roof



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❖Communications



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3rd Ventricle



Lateral wall



Anterior wall

- Column of fornix
- Ant commissure
- Lamina terminalis

Lateral wall

- Thalamus
- Hypothalamus

Posterior wall

- Pineal body
- Post commissure

Floor

- Optic chiasma
- Tuber cinereum & infundibulum
- Mammillary body
- Post perforated sub
- Midbrain tegmentum

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Recesses of third ventricle



Suprapineal recess

Pineal recess

Optic recess

Infundibular recess

Lecture Quiz



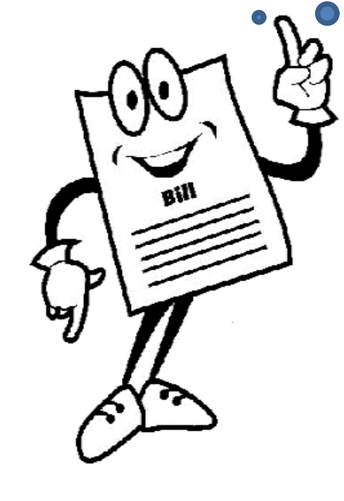
- *Which of the following structures forms the anterior wall of 3rd ventricle?*

a) Mamillary body
b) Lamina terminalis
c) Pineal body
d) Optic chiasma

Lecture Summary







-Define the diencephalon and its parts.

-Mention the major relations & blood supply of the thalamus

-List the different thalamic nuclei and their connections and functions.

List parts and connections of metathalamus

Describe the parts of hypothalamus, epithalamus & subthalamus.

-Describe the communications boundaries & recesses of the third ventricle.

SUGGESTED TEXTBOOKS



1. Snell's Clinical Neuroanatomy -8th Edition

Atlas of human anatomy by Frank H. Netter, 6th Edition

Thank you!